LISTING OF THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (Currently Amended)

A reactor system comprising a reactor for reacting at least a ~~first~~reactant fluid comprising a ~~first~~ reactant and a ~~second~~ co-reactant fluid comprising a ~~second~~ co-reactant, and mixing a diluent fluid comprising a diluent with one or more portions of ~~first~~ reactant fluid, ~~second~~ co-reactant fluid and/or products of their reaction to form a ~~reaction~~ product fluid, the reactor comprising:

a duct having ~~an axial~~ a local streamwise flow direction along a streamwise curvilinear fluid flow path and a first and second transverse directions mutually distinct from the ~~axial~~ flow direction, the first and second transverse directions defining a ~~plane~~ transverse surface through ~~an axial~~a reactor location~~, with the area of the plane within the inner surface of the duct defining a cross-sectional area of the duct at the axial location;~~ transverse to the flow;

a reactant distribution portion comprising at least one reactant tubular portion having an inner surface and an outer surface, the inner surface defining a ~~first~~reactant flow path for the ~~first~~reactant fluid, and having a plurality of reactant distribution orifices extending from the inner surface to the outer surface, the plurality of reactant distribution orifices having ~~a~~ an areal number density distribution, being the locally averaged ~~spatial density~~ distribution of the number of orifices per ~~duct cross-sectional area~~unit duct area transverse to the flow, and having a size distribution, the distributions being with respect to at least one of the transverse directions~~;~~ and;

a diluent distribution portion comprising at least one diluent tubular portion having an inner surface and an outer surface, the inner surface defining a first diluent flow path for the diluent, and a plurality of diluent orifices extending from the inner surface to the outer surface of the diluent tubular portion, the plurality of diluent orifices having ~~a~~an areal number density distribution and a size distribution, the distributions being with respect to at least one of the transverse directions;

a reactant delivery system for supplying the ~~first~~reactant fluid to the reactant distribution portion;

~~a second~~a co-reactant fluid delivery system for supplying at least a portion of the ~~second fluid~~co-reactant to the duct, wherein the duct defines a ~~second~~streamwise co-reactant flow path for the ~~second~~co-reactant fluid;

a diluent delivery system for supplying at least a portion of diluent to the diluent distribution portion;

a controller for controlling the delivery of at least one of the ~~first~~ reactant fluid, the ~~second~~ co-reactant fluid and the diluent fluid to the reactor; and

wherein at least one of the reactant and diluent orifice spatial density and orifice size ~~distribution, with respect to at least one of the~~ transverse ~~directions, of the diluent orifices and of the reactant orifices are configured such that the distribution of at least one of the composition, temperature, pressure and velocity of the reaction product,~~distributions is ~~controlled in the at least one transverse direction in a cross section of the duct near the reactor exit, taken along a direction transverse to the duct axis.~~not spatially uniform.

Claim 2 (Currently Amended)

The reactor of claim 1 further comprising numerous delivery regions wherein the spacing ~~of~~ between at least two nearby distribution orifices, the distance to an adjacent tubular distribution portion in a transverse direction, and a ~~similar~~corresponding third distance selected in ~~an axial downstream~~ the streamwise fluid flow direction define the delivery region about at least one orifice, wherein the delivery of fluid through that orifice is controlled within that delivery region.

Claim 3 (Currently Amended)

The reactor of claim 2 wherein the distribution of the ratio of ~~first~~ reactant to ~~second~~ co-reactant is controlled in a direction transverse to the ~~duct axis~~ streamwise flow

direction by controlling the relative delivery of the ~~first~~ reactant ~~relative~~ flow to the flow of the ~~second~~ co-reactant within numerous delivery regions within the duct.

Claim 4 (Currently Amended)

The reactor of claim 2 wherein the defined delivery regions comprise a plurality of delivery sub-regions and at least one reactant orifice and one diluent orifice each of which deliver fluid into one or more delivery sub-regions within the delivery region.

Claim 5 (Currently Amended)

The reactor of claim 4 wherein a diluent richer delivery sub-region is further controlled to ~~be diluent richer with~~have a higher diluent to ~~first~~ reactant ratio, compared to another diluent leaner delivery sub-region controlled to ~~be diluent leaner having~~have a lower diluent to ~~first~~ reactant ratio.

Claim 6 (Original)

The reactor of claim 5 wherein at least one of the diluent leaner sub-regions comprises a combustible mixture.

Claim 7 (Currently Amended)

The reactor of claim ~~1~~ 2 further comprising delivery regions having diluent compositions less than a quench composition of ~~first reactant, second reactant and~~ diluent relative to reactant and co-reactant at a given temperature, where a ~~greater~~ diluent composition greater than the quench composition will quench the reaction to below the self sustaining rate at that temperature.

Claim 8 (Currently Amended)

The reactor of claim 1 wherein the total amount of diluent delivered to the reactor exceeds the quench composition for a hypothetical composition of diluent premixed ~~composition~~together with the total ~~first~~ co-reactant and total ~~second~~ co-reactant delivered to the reactor.

Claim 9 (Currently Amended)

The reactor of claim 8 wherein the amount of diluent delivered to ~~spatial sub-regions as defined by at least~~ a delivery region between two tubular portions, comprising a plurality of spatial sub-regions, as defined by the spacing between adjacent diluent fluid distribution orifices~~and~~, a fraction of the distance to an adjacent tubular diluent distribution portion~~ are either above or below~~, and a streamwise flow distance is below the ~~thermal~~ quench ~~limit.~~composition.

Claim 10 (Currently Amended)

The reactor of claim 9 wherein the diluent delivered to at least one delivery region is below 100% and greater than about 68% of the quench composition for the ~~first~~ reactant and ~~second reactants~~ co-reactant for that specified region.

Claim 11 (Currently Amended)

The reactor of claim 9 wherein the diluent delivered to at least one delivery sub-region within a delivery region between tubular distribution portions is below 100% and greater than about 68% of the quench composition for the ~~first~~ reactant and ~~second reactants~~ co-reactant for that specified sub-region.

Claim 12 (Currently Amended)

The reactor of claim 9 wherein the ~~reactible~~reactable delivery sub-regions with delivered diluent amounts below the quench composition concentration within that region are interspersed with non-~~reactible~~reactable delivery sub-regions with delivered diluent amounts above the quench composition concentration.

Claim 13 (Currently Amended)

The reactor of claim 12 wherein the reactable delivery sub-regions comprise evaporated diluent below the quench composition concentration plus liquid diluent~~.~~, at

least a portion of which evaporates after the ~~start~~upstream boundary of the reaction~~.~~ region.

Claim 14 (Currently Amended)

The reactor of claim 1 wherein at least a portion of at least part of the diluent delivery portion is positioned upstream of the ~~first~~ reactant delivery portion in the reactor.

Claim 15 (Currently Amended)

The reactor of claim 14 wherein a portion of the diluent is evaporated prior to the location of onset of rapid reaction between the ~~first~~ reactant and ~~second reactants.~~co-reactant.

Claim 16 (Currently Amended)

The reactor of claim 1 wherein the diluent orifice distribution is configured such that ~~all~~a prescribed portion of the diluent is evaporated ~~prior to~~within a specified distribution of evaporation ~~axial~~ distance along a streamwise curvilinear flow path, the distributions being in a direction transverse to the ~~duct axis.~~streamwise flow direction.

Claim 17 (Currently Amended)

The reactor of claim 1 wherein the one or more of the distribution of diluent orifice size, diluent orifice spatial number density, differential delivery pressure across the orifices, and tubular portion gap are configured so that all of the diluent is effectively evaporated prior to ~~the~~a specified distribution of an evaporation distance along a curvilinear flow path, the distribution taken in a direction transverse to the curvilinear fluid flow direction.

Claim 18 (Currently Amended)

The reactor of claim 1 wherein the transverse distribution~~.The reactor~~ of ~~claim 1 wherein the~~local standard deviation of the prescribed ~~first fluid distribution~~ reactant fluid delivery varies by less than 15% of mass flow over at least 80% of the duct cross-sectional area~~.~~ transverse to the flow.

Claim 19 (Currently Amended)

The reactor of claim 1, further comprising at least one tubular portion, each tubular portion having one effective outer surface and a plurality of inner walls defining a plurality of flow paths for ~~a liquid or gaseous fluid~~at least one of ~~either~~ the reactant fluid ~~or~~and the diluent fluid.

Claim 20 (Currently Amended)

The reactor of claim 1 wherein diluent fluid and reactant fluid are delivered through ~~at least two or more~~ a plurality of passages.

Claim 21 (Currently Amended)

The reactor of claim 1 further comprising an igniter configured to ignite a reaction between the ~~first~~reactant fluid and the ~~second~~co-reactant fluid.

Claim 22 (Currently Amended)

The reactor as in claim 1 wherein the at least one tubular portion of the reactant distribution portion is located adjacent to the at least one diluent tubular portion of the diluent distribution portion to provide temperature control of at least a portion of the reactant distribution portion.

Claim 23 (Currently Amended)

The reactor of claim 22 wherein at least a portion of at least one diluent tubular portion is configured near at least a portion of the at least one reactant distribution portion, wherein constraining the temperature of the ~~first second~~reactant fluid and wherein reducing undesired thermal reaction products from occluding the reactant orifices.

Claim 24 (Currently Amended)

The reactor of claim 1 wherein the transverse distribution of orifice orientation of the diluent orifices ~~are~~is configured to control the distribution of diluent delivery in at least one transverse direction.

Claim 25 (Currently Amended)

The reactor of claim 1 wherein the diluent orifices have a cone angle having an inward or outward orientation and the transverse distribution of these cone angles is varied in at least one of the transverse directions~~ is varied.~~.

Claim 26 (Currently Amended)

The reactor of claim 1 further comprising at least one heat exchange system comprising a heat exchange wall in one of radiation view or fluid contact with the ~~reactor.~~product fluid.

Claim 27 (Currently Amended)

The reactor of claim ~~1~~26 wherein the heat exchange wall further comprises one or more of an insulating layer, a perforated radiation shield, one or more radiation shields, operable to control the heat transfer properties of the wall, one or more of the thermal resistance of an insulating layer, the coverage of an insulating layer, the degree of perforation of the perforated radiation shield, and the distribution of the number of radiation shields, being configured to control the heat transfer between the ~~energetic~~product fluid and the heat exchange wall.

Claim 28 (Currently Amended)

The reactor of ~~claim~~claim 1 wherein the reactor system further comprises a plurality of narrow passages between one or more of diluent tubular portions downstream of formation of a ~~reactible~~reactable mixture of ~~first~~reactant fluid and ~~second~~co-reactant fluid within the fluid duct, the narrow passages sized to ~~be operable to~~ constrain a downstream flame from propagating upstream ~~of~~ through the narrow passages.

Claim 29 (Currently Amended)

The reactor of claim 1 wherein the duct further comprises a diffuser positioned at least partially upstream of the reactant distribution portion wherein reducing the velocity of the ~~second~~<u>co-reactant</u> fluid.

Claim 30 (Currently Amended)

The reactor of claim 29 wherein the diffuser comprises a plurality of flow splitter vanes configured to form a plurality of diffuser passages affecting the velocity of ~~second~~ <u>co-reactant</u> fluid flow therein.

Claim 31 (Currently Amended)

The reactor of claim ~~29~~<u>30</u> wherein the plurality diffuser passages are configured to achieve a desired transverse distribution of ~~an axial~~ <u>a flow direction</u> mass flow rate of the ~~second~~<u>co-reactant</u> fluid in at least one of the transverse directions downstream of the diffuser.

Claim 32 (Currently Amended)

The reactor of claim ~~29~~<u>30</u> wherein the desired transverse ~~second~~<u>co-reactant</u> fluid <u>flow</u> distribution is uniform~~. The reactor~~ <u>within a prescribed uncertainty over at least 80%</u> of ~~claim 29 wherein~~ the ~~desired~~<u>duct cross-section</u> transverse ~~second fluid~~<u>to the flow.</u>

Claim 33 (Currently Amended)

<u>The reactor of claim 29 wherein the desired transverse co-reactant fluid flow</u> distribution is higher near walls of the duct downstream of the diffuser as compared to the center of the duct.

Claim 34 (Currently Amended)

The reactor of claim ~~29~~<u>30</u> configuring the plurality of diffuser passages are configured to achieve a transverse distribution of the ~~axial~~<u>flow direction</u> mass flow rate

in the duct wherein the standard deviation of the ~~axial~~ streamwise flow direction mass flow rate is less than 15 % of a prescribed transverse distribution of the ~~axial~~flow direction mass flow rate, evaluated in a duct cross section transverse to the flow downstream of the diffuser and upstream of the start of reaction.

Claim 35 (Currently Amended)

The reactor of claim ~~29~~30 wherein each of the plurality of diffuser passages define an inlet area and an outlet area and wherein the ratios of the outlet area to the inlet area of each of diffuser passages are configured to reach a desired transverse distribution of ~~an axial~~a flow direction mass flow rate of the ~~second~~co-reactant fluid in at least one of the transverse directions downstream of the diffuser.

Claim 36 (Currently Amended)

The reactor of claim ~~29~~30 wherein each of the plurality of diffuser passages define an included angle between adjacent diffuser passage walls that is between about 4 and 14 degrees.

Claim 37 (Currently Amended)

The reactor of claim ~~29~~30 wherein at least a portion of the at least one diluent tubular portion ~~are~~ is positioned substantially perpendicular to ~~and near a downstream edge of~~ the fluid splitter vanes forming the diffuser passages.

Claim 38 (Currently Amended)

The reactor of claim ~~29~~ 30 wherein at least a portion of the at least one diluent tubular portion ~~are~~ is positioned substantially parallel to and near a downstream edge of at least one of the fluid splitter vanes forming the diffuser passages.

Claim 39 (Currently Amended)

The reactor of claim 29 wherein at least a portion of the diluent delivery system is located downstream the ~~exit of the~~ diffuser inlet and upstream of at least a portion of the fuel delivery system.

Claim 40 (Currently Amended)

A method of reacting ~~a first reactant with a second reactant and mixing a diluent fluid with at least one of the first and second reactants and a reaction product to form a product fluid; the~~ reactants in the presence of diluent, the method comprising:

~~providing~~configuring a reactor; the reactor having ~~an axial~~a streamwise curvilinear fluid flow direction and a first and second transverse directions mutually distinct from the ~~axial~~streamwise flow direction, the first and second transverse directions defining a ~~plane~~surface through ~~an axial~~a reactor location~~, with the area of the plane constrained within an inner surface of the reaction defining a cross-sectional area of the reaction at the axial location;~~ transverse to the flow;

~~providing~~configuring a ~~first~~ reactant delivery system ~~to deliver~~and delivering a ~~first~~ reactant fluid comprising ~~the first~~ reactant to the reactor;

~~providing~~configuring a ~~second~~ co-reactant delivery system ~~to deliver~~and delivering a ~~second~~ co-reactant fluid comprising the ~~second~~ co-reactant to the reactor;

~~providing a diluent delivery system to deliver the diluent fluid to the reactor;~~

~~controlling the spatial delivery of the second reactant fluid into the reactor in at least one of the transverse directions;~~

controlling the spatial delivery of the ~~diluent~~reactant fluid comprising reactant into the reactor in at least one of the transverse directions; ~~and~~

~~wherein controlling the at least one spatial distribution of the second reactant fluid and the diluent in at least one of the transverse directions controls at least one of the composition, temperature, pressure and velocity of the reaction product, in at least one transverse direction near an exit of the reactor taken in a cross section of the reactor.~~

configuring a diluent delivery system and delivering the diluent fluid to the reactor;

controlling a spatial delivery distribution of a diluent fluid comprising a diluent into the reactor, the distribution being taken in at least one of the transverse directions;

reacting reactant with co-reactant to form a reaction product, and mixing diluent with at least one of reactant, co-reactant and reaction product, and

delivering to an outlet of the reactor a product fluid comprising reaction product, diluent and a residual component comprising at least one of reactant and co-reactant; and

wherein controlling the at least one spatial distribution of each of the reactant fluid and the diluent fluid in at least one of the transverse directions controls the transverse distribution of at least one of the composition, temperature, pressure and streamwise velocity of the product fluid, near the reactor in at least one of the transverse directions.

Claim 41 (Currently Amended)

The method of claim 40 wherein the diluent fluid comprises at least one of fluid water~~.~~ and carbon dioxide.

Claim 42 (Currently Amended)

The method of claim 40 further including controlling the mean outlet temperature of the product fluid exiting the reactor by controlling the amount of diluent delivered through the diluent delivery system~~.~~ to control the total enthalpy change relative to the heat of reaction and the fluid delivery temperatures.

Claim 43 (Currently Amended)

The method of claim 40 further ~~including~~ acoustically ~~exciting~~modulating the delivery of at least one of the delivered fluids thereby acoustically modulating the reacting fluid within the reactor.

Claim 44 (Currently Amended)

The method of claim 43 further including ~~exciting the~~modulating the delivered fluid to at least 10 Hz.

Claim 45 (Currently Amended)

The method of claim 40 further including modulating the spatial delivery of the ~~second~~reactant fluid into the reactor to ~~reducing~~reduce fluid pressure oscillation within the reactor.

Claim 46 (Currently Amended)

The method of claim 40 further including modulating the spatial delivery of the diluent fluid into the reactor to reduce fluid pressure oscillation within the reactor.

Claim 47 (Currently Amended)

The method of claim 40 further including electrically exciting at least a portion of the ~~reaction electrically.~~ hot fluid within the reactor.

Claim 48 (Currently Amended)

The method of claim 47 further including ~~generating a flame region and exciting the flame region~~ modulating the hot fluid to at least 2 kHz.

Claim 49 (Currently Amended)

The method of claim 40 further including ~~providing~~configuring a diffuser and diffusing the co-reactant in the reactor and delivering a portion of the diluent as one of diluent vapor and steam, near the diffuser ~~exit.~~outlet.

Claim 50 (Currently Amended)

The method of claim 40 further including ~~providing~~configuring a diffuser, diffusing the co-reactant in the reactor and delivering a portion of the diluent as liquid near the diffuser ~~exit.~~outlet.

Claim 51 (Currently Amended)

The method of claim 40 wherein at least a portion of the ~~liquid~~ diluent delivered by the diluent delivery system ~~remains unevaporated~~ comprises one of diluent liquid and liquid water, and is delivered as ~~it enters~~a liquid into the reactor.

Claim 52 (Currently Amended)

The method of claim 40 further including delivering liquid and vapor diluent to the reactor and wherein at least a portion of the liquid diluent is delivered to the ~~reactor~~reactor streamwise downstream of the vapor diluent delivery.

Claim 53 (Currently Amended)

The method of claim 40 wherein the ~~second~~ reactant delivery system and the ~~second reactant~~ diluent delivery system are configured to form interspersed ~~combustible~~reactable and non-~~combustible~~reactable regions and further comprising providing a ~~transverse~~ traversing region of ~~combustible~~reactable fluid traversing at least one of the ~~combustible and~~ non-~~combustible~~reactable regions~~.~~ from one reactable region to another.

Claim 54 (Currently Amended)

The method of claim 40 wherein the ~~first~~ co-reactant comprises oxygen containing fluid, the ~~second~~ reactant comprises a combustible fuel, and the diluent comprises at least one of a vaporizable liquid, and liquid water.

Claim 55 (Currently Amended)

The method of claim ~~40~~41 further including combusting the ~~first reactant~~fuel with the ~~second reactant~~oxidant within the ~~combustion chamber.~~ reactor.

Claim 56 (Currently Amended)

The method of claim 40 wherein at least a portion of the diluent is delivered streamwise downstream of a ~~flame~~ rapid reaction front.

Claim 57 (Currently Amended)

The method of claim 40 further including controlling the evaporation of ~~the~~ a vaporizable portion of diluent by controlling ~~an axial~~a streamwise flow direction velocity distribution of the diluent ~~away~~as delivered from ~~a~~the diluent delivery system ~~diluent~~ evaluated along at least a first transverse direction.

Claim 58 (Currently Amended)

The method of claim 40 further including controlling the streamwise evaporation distance of the diluent in the reactor with respect to at least one of the transverse directions.

Claim 59 (Currently Amended)

The method of claim 40 further including ~~providing~~ configuring a high voltage power supply ~~to~~for at least one of the ~~second~~ reactant delivery system or the diluent delivery system and generating a high voltage electric field within the reactor.

Claim 60 (Currently Amended)

The method of claim 59 further including ~~oscillating~~modulating the high voltage electric fields.

Claim 61 (Currently Amended)

The method of claim 40 further including providing at least a portion of the reactor with coolant passages ~~and~~ , cooling at least a portion of ~~at a portion of~~ the reactor with diluent ~~which is subsequently delivered~~, and delivering at least a portion of the heated diluent to the reactor.

Claim 62 (Currently Amended)

The method of claim 40 further including controlling the temperature of the ~~energetic~~product fluid exiting the ~~combustor~~reactor by controlling the total diluent enthalpy change ~~independently of the flow of vaporized~~comprising vaporizable diluent being delivered to the ~~combustor.~~reactor.

Claim 63 (Currently Amended)

A fluid delivery system comprising:

a pump comprising at least one pump member ~~that moves in~~ operable to move in at least one of a reciprocal ~~or~~and rotational ~~manner~~movement to deliver a fluid with a flow delivery distribution per periodic pump cycle, and operable ~~of moving~~to move through ~~a plurality of~~at least one fluid delivery cycles~~;~~;

a motor comprising at least one motor member operationally coupled to the at least one pump member and operable to produce said reciprocal or rotational movement; and

a controller operationally connected to the motor and configured to control the motor excitation whereby controlling the reciprocal or rotational movement of the at least one pump member;

wherein the controller ~~being~~ is configured to vary the temporal distribution of at least one of a motor force or torque actuating the reciprocal or rotational ~~movement of the at least one~~ pump ~~member within a single~~ movement within at least one pump cycle so as to control the temporal flow delivery distribution of the ~~flow~~ fluid delivered by the pump;

wherein the controller ~~being operable~~is configured to reduce the flow delivery fluctuations relative to those formed by a sinusoidal motor ~~actuation.~~ excitation.

Claim 64 (Currently Amended)

The fluid delivery system as in claim 63 further comprising at least one position reference sensor able to provide at least one position reference per motor cycle, and at least one motion sensor able to determine one or more of the acceleration, speed and position of the motor member, and the controller including a feed back routine that utilizes said sensors for varying the motor ~~actuation~~excitation of the reciprocal or rotational movement of the at least one pump member within the fluid delivery cycle.

Claim 65 (Original)

The fluid delivery system as in claim 64 wherein the motion sensor is operable to provide at least 1,000 measurements per pump cycle.

Claim 66 (Currently Amended)

The fluid delivery system as in claim 64 wherein the controller is ~~operable to change the motor torque at least 1,000 times per second.~~configured to apply a prescribed electromagnetic excitation to the motor within 1 ms.

Claim 67 (Original)

The fluid delivery system as in claim 64 wherein a motor position sensor used is operable to provide at least 2,000 measurements per pump cycle with a resolution of at least 0.05%, and the controller is operable to change the motor torque with a closed loop bandwidth of at least 2 thousand times per second.

Claim 68 (Original)

The fluid delivery system as in claim 63 wherein a motor rotor has a torque to inertia ratio of at least 10,000 reciprocal seconds squared.

Claim 69 (Currently Amended)

The fluid delivery system as in claim 63 wherein a motor rotor and stator are cooled using a vaporizable coolant, and the motor rotor has a ratio of torque to inertia ~~ratio~~ of at least 30,000 reciprocal seconds squared.

Claim 70 (Currently Amended)

The fluid delivery system as in claim 63 wherein the pump is operable to deliver at least one of a reactant liquid comprising a reactant, and a diluent liquid.

Claim 71 (Original)

The fluid delivery system as in claim 63 wherein the pump comprises a first pump member operable to deliver a reactant liquid comprising a reactant, and a second pump member operable to deliver a diluent liquid.

Claim 72 (Currently Amended)

The fluid delivery system as in claim ~~71~~63 wherein the pump comprises a first pump member actuated by a first motor rotor ~~with~~comprising at least one first motor sensor~~s~~, and a second pump member actuated by a second motor rotor ~~with~~comprising at least one second motor sensor~~s~~, and wherein the controller is operable to control the motor rotors independently.

Claim 73 (Currently Amended)

The fluid delivery system as in claim 70 wherein the pump is coupled to a~~n~~ ~~elongated~~ fluid distribution member comprising numerous orifices ~~delivering~~operable to deliver at least one of the ~~liquid~~liquids into the surrounding space.

Claim 74 (Currently Amended)

The fluid delivery system as in claim 73 wherein the ~~elongated~~ fluid distribution member is configured ~~into~~to provide a spatial array of orifices having a greatest transverse ~~dimension~~width, wherein the pump is positioned within the distance of the greatest transverse ~~dimension of~~width from the center of the distribution array.

Claim 75 (Currently Amended)

A method of ~~designing~~configuring a reactor for reacting at least ~~two reactants~~a reactant fluid comprising a reactant, and a co-reactant fluid comprising a co-reactant, diluted by a diluent to form a reaction product, the reactor comprising:

a duct having ~~an axial~~a curvilinear streamwise fluid flow direction and a first and second transverse directions mutually distinct from the ~~axial~~fluid flow direction, the first and second transverse directions defining a ~~plane through an axial location, with the area of the plane constrained within the inner~~ surface ~~of the duct defining a cross-sectional area of the duct at~~through a reactor location transverse to the ~~axial location;~~flow;

a~~ first~~ reactant distribution portion comprising at least one tubular portion having an outer surface and an inner surface, the inner surface defining a first reactant flow path for the ~~first~~reactant fluid, and a plurality of ~~first~~reactant fluid distribution orifices extending from the inner surface to the outer surface, the plurality of ~~first~~ reactant

distribution orifices having a ~~spatial~~spatial areal number density distribution and a size distribution with respect to at least one of the transverse directions;

a diluent distribution portion comprising at least one diluent tubular portion having an outer surface and an inner surface, the inner surface defining a first diluent flow path for the diluent fluid, and a plurality of diluent orifices extending from the inner surface to the outer surface of the diluent tubular portion, the plurality of diluent orifices having a spatial areal number density distribution and size distribution with respect to at least one of the transverse directions;

the method comprising:

determining the desired delivery mass flow rates for ~~a first~~ the reactant fluid comprising ~~a first~~ reactant, ~~a second~~ the co-reactant fluid comprising ~~a second~~ co-reactant, and a diluent fluid, the fluid inlet parameters and the desired output pressure and temperature of the ~~reaction~~ product fluid exiting the reactor;

configuring the ~~first~~ reactant distribution portion;

configuring the duct which defines a ~~second~~ co-reactant flow path for the ~~second~~ co-reactant fluid;

determining a transverse distribution of ~~axial~~ flow direction velocity of the ~~second~~ co-reactant fluid with respect to at least one of the transverse directions;

configuring ~~the diluent distribution portion;configuring~~at least one of the spatial density distribution and size distribution of the ~~first~~ reactant orifices with respect to at least one of the transverse directions; and

configuring the diluent distribution portion comprising configuring at least one of the spatial density distribution and size distribution of the diluent orifices with respect to at least one of the transverse directions;

wherein achieving a desired transverse distribution, in at least one of the transverse directions, of at least one of the composition ratio of ~~second~~ co-reactant concentration to ~~first~~ reactant concentration, and the temperature of the product fluid comprising a reactant product, with respect to at least one of the transverse directions.

Claim 76 (Currently Amended)

A method of reacting a ~~first~~ reactant with a ~~second~~ co-reactant and mixing a diluent fluid with at least one of the ~~first~~ reactant and ~~second reactants and~~ co-reactant and a reaction product to form a product fluid; the method comprising:

~~providing~~configuring a reactor; the reactor having ~~an axial~~a streamwise fluid flow direction and a first and second transverse directions mutually distinct from the ~~axial~~flow direction, the first and second transverse directions defining a ~~plane~~ surface through ~~an axial~~ a reactor location~~, with the area of the plane constrained within an inner surface of the reaction defining a cross-sectional area of the reactor at the axial location;~~ transverse to the flow;

~~providing~~delivering a ~~first reactant delivery system to deliver a first~~ reactant fluid comprising the ~~first~~ reactant with a spatial distribution to the reactor~~;providing~~ through a ~~second~~ reactant delivery system ~~to deliver~~;

delivering a ~~second~~co- reactant fluid comprising the ~~second~~ co-reactant to the reactor with a spatial distribution; the ~~second reactant~~ delivery ~~system~~ comprising ~~a diffuser that comprises~~diffusing the co-reactant into the reactor through a plurality of passages;

~~providing a diluent delivery system to deliver~~delivering the diluent fluid comprising the diluent with a spatial distribution to the reactor~~;~~ through a diluent delivery system;

~~controlling the spatial delivery of the first reactant fluid into the reactor in at least one of the transverse directions;~~

~~controlling the spatial delivery of the diluent fluid into the reactor in at least one of the transverse directions; and~~ wherein controlling the at least one spatial distribution of the ~~second~~ co-reactant fluid and the diluent fluid in at least one of the transverse directions~~.~~; and

wherein controlling at least one of the composition, temperature, pressure and velocity of the reaction product, in at least one transverse direction near an ~~exit~~outlet of the reactor taken in ~~a cross section of the reactor.~~ the surface along a direction transverse to the flow.

Claim 77 (Currently Amended)

A method of accurately controlling ~~the composition of a reaction fluid formed by~~ a reaction between ~~two~~ reactant and co-reactant fluids, the method comprising:

~~delivering a first liquid reactant to a reactor through a reactant distributed contactor positioned within a duct in the reactor;~~

~~delivering a second fluid co-reactant through multiple fluid passages into the duct; the duct having an axial direction and a first and second transverse directions mutually distinct from the axial direction, the first and second transverse directions defining a plane through an axial location, with the area of the plane constrained within an inner surface of the reaction defining a cross-sectional area of the reaction at the axial location;~~

~~configuring the reactant distributed contactor to control the spatial delivery of the first liquid reactant into the reactor in at least one of the transverse directions; and~~

~~measuring the residual component concentration of one of the reactant and the co-reactant;~~

~~wherein the measured residual component concentration is less than 15% of the concentration of the reactant or co-reactant within the reactor upstream of the reaction;~~

~~wherein the sensor measuring the residual component concentration is operable to measure the residual component concentration with an uncertainty of less than +/-0.5% of the total flow;~~

~~measuring the mass flow rate of first reactant with an uncertainty of less than +/-1% of the total flow;~~

~~sampling the reaction product at multiple locations across the reactor outlet sufficient to measure the residual component concentration wherein achieving an uncertainty of about +/-1% in the ratio of second reactant to first reactant.~~

delivering a reactant fluid comprising a reactant into numerous regions within a reactor with a non-uniform spatial reactant fluid delivery distribution across the regions;

delivering a co-reactant fluid comprising a co-reactant into the numerous regions with a spatially non-uniform co-reactant fluid delivery distribution across the regions;

mixing and reacting the reactant and the co-reactant fluids within and downstream of the numerous regions, whereby forming a reactor product fluid flow comprising reaction product, and at least one of reactant and co-reactant;

measuring a downstream residual concentration of the greater of reactant or co-reactant in the reactor product fluid downstream of the majority of the reaction between the reactant and co-reactant fluids;

controlling a delivery ratio of co-reactant fluid flow rate to the reactant fluid flow rate to within a prescribed range, based on the downstream residual concentration.

Claim 78 (Currently Amended)

The method of claim 40 further comprising controlling the delivery of diluent fluid and ~~first~~ reactant fluid to the reactor to control the pressure within the reactor to within ~~the specified compressor surge boundaries above which pressure causes surge in the second reactant~~ at least one specified safe operating bound of the co-reactant fluid delivery system.

Claim 79 (Currently Amended)

The method of claim 78 further comprising controlling the ~~delivery of diluent fluid and first reactant fluid to control the pressure within the reactor to within the specified compressor surge boundaries and to control the temp~~temperature of the product fluid.

Claim 80 (Currently Amended)

The method of claim 78 further comprising controlling the spatial distributions of the delivery of diluent fluid and of ~~first~~ reactant fluid to the reactor wherein controlling the spatial distribution of pressure within the reactor in at least one of the transverse directions to within the ~~specified compressor surge boundaries~~at least one specified safe operating bound, and controlling the distribution of temperature of the product fluid in at least one of the transverse directions.

Claim 81 (Currently Amended)

A method of controlling a pressurized reactor; the method comprising:

providing a reactor; the reactor having ~~an axial direction and~~ a curvilinear streamwise flow direction and first and second transverse directions mutually distinct from the ~~axial~~flow direction, the first and second transverse directions defining a ~~plane~~ surface through ~~an axial~~a reactor location~~, with~~ transverse to the ~~area of the plane constrained within an inner surface of the reaction defining a cross-sectional area of the reaction at the axial location;~~flow;

providing a ~~first~~ reactant delivery system to deliver a ~~first reactant fluid comprising a first reactant to the reactor;~~

~~providing a second reactant delivery system to deliver a second~~ reactant fluid comprising a ~~second~~ reactant to the reactor;

providing a co-reactant delivery system comprising a compressor to deliver a co-reactant fluid comprising a co-reactant to the reactor;

providing a -diluent delivery system to deliver a diluent fluid comprising a vaporizable diluent to the reactor;

wherein the pressures of the reactant, co-reactant and diluent fluids are above ambient;

reacting at least a ~~first~~ portion of reactant with ~~a second~~ co-reactant whereby forming a reaction product;

mixing a portion of diluent fluid with at least one of the ~~first and second~~ reactant and co-reactants and ~~a~~ the reaction product whereby forming a product fluid comprising ~~a~~ reaction product and diluent;

and controlling the delivery of at least one of diluent fluid and ~~first~~ reactant fluid to the reactor ~~-to control~~wherein controlling the pressure within the reactor to within at least one specified compressor ~~surge boundaries above which pressure causes surge in the second reactant delivery system.~~safe operating bound.

Claim 82 (Original)

The method of claim 81 further including controlling the temperature of the product fluid.

Claim 83 (Currently Amended)

The method of claim 81 further including controlling the ~~spatial~~ delivery of at least one of the ~~second~~ co-reactant fluid into the reactor with a spatial distribution prescribed in at least one of the transverse directions~~.~~, and ~~controlling the spatial delivery of~~ the diluent fluid into the reactor ~~in at least one of the transverse directions wherein controlling the at least one~~with a spatial distribution ~~of the second reactant fluid and the diluent~~prescribed in at least one of the transverse directions ~~controls~~ wherein controlling at least one spatial distribution of at least one of the composition, temperature, pressure and velocity of the ~~reaction~~ product fluid, in a surface along at least one direction transverse ~~direction~~to the flow near an ~~exit~~outlet of the reactor ~~taken in a cross section of the reactor.~~.

Claim 84 (Currently Amended)

The method of claim ~~83~~81 further comprising controlling the spatial distributions of the delivery of both diluent fluid and ~~OF first~~ of reactant fluid to the reactor -wherein controlling the spatial distribution of pressure within the reactor in at least one of the transverse directions to within the at least one specified compressor ~~surge boundaries~~safe operating bound, and controlling the spatial distribution of temperature of the product fluid ~~in at least one of the transverse directions,~~ the spatial distributions being ~~taken~~evaluated in at least one of the directions transverse ~~directions.~~to the streamwise flow near the reactor outlet.